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James E. Webb
Administrator

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

before the
Subcommittee on Aviation
Committee on Commerce
United States Senate

Mr. Chairman and Members of the Subcommittee:

During its existence from the time Congress founded it in 1915 as an independent Federal agency, until it was absorbed by the new NASA when that organization was created in 1958 the National Advisory Committee for Aeronautics sought to accelerate the development of aircraft, both civil and military. Briefly, the NACA mission was to anticipate the research needs of aeronautics; to build the scientific staff and unique research facilities required to meet these research needs; and to acquire the needed new knowledge as rapidly as the national interest required.

By discharging its primary responsibliity - scientific laboratory and flight research in aeronautics - the NACA served the needs of all departments of the Government, and to a great extent, the needs of the aircraft industry in the United States.

The NACA research programs had both the all-inclusive long-range objective of acquiring new scientific knowledge essential to assure United States leadership in aeronautics, and the more immediate goal of solving, as quickly as possible, the most pressing problems. In this way, they effectively supported the Nation's aircraft and missile construction program.

A major task of the NACA, since its beginning in 1915, was to coordinate aeronautical research in the United States. Through the members of the Committee and its 28 technical subcommittees, the NACA linked the military and civil government agencies concerned with flight. The aviation industry, allied industries, and scientific institutions were all represented on these working groups.

Assisting the Committee in determining and coordinating its research programs were 4 major and 24 subordinate technical committees with a total membership of nearly 500. Members were chosen because of technical ability, experience, and recognized leadership in a special field. They served without pay, in a personal and professional capacity. They furnished valuable assistance in considering problems related to their technological fields, reviewed research in progress at NACA laboratories and in other establishments, recommended new research to be undertaken, and assisted in coordinating research programs.

The chief function of the NACA was to provide information and advanced technology in the field of aeronautics for application by aircraft users and manufacturers both military and civil. This function was carried out by a competent engineering and scientific staff using the latest test facilities. The program was largely an in-house program - the staff, equipment, and facilities having been built up over the years. Today, the NASA, in pursuing its aeronautical research program operates numerous ground-based research facilities such as wind tunnels, structures and materials laboratories and simulators, and performs flight research with the use of full-scale aircraft. Research is carried out in such technical disciplines as: performance aerodynamics, stability and control, structures, materials, structural dynamics and loads, operational problems and airworthiness. Research in the various technical disciplines is usually focused on a certain aircraft type such as: V/STOL aircraft, conventional subsonic aircraft, supersonic aircraft, or hypersonic aircraft. Today's NASA aeronautical research program is being pursued in the NASA research centers in the familiar framework of theoretical and experimental research activity of its predecessor, the NACA. As has always been the case, the detailed objectives of the program change with the times to suit the national needs as far as such needs are apparent or can be envisioned.

As in the case of the NACA, we do not specify, design, or develop other than research aircraft, these functions being the missions of other Government agencies or private activities. Nevertheless, we do not consider our research completed until it has been reduced to practice, and we accordingly provide technical assistance to those who develop and operate aircraft, either to preserve the peace or to earn a fair return on invested capital.

In carrying out this research mission, we long ago appreciated the necessity for full cooperation and coordination with the other agencies of the Government concerned with the industry. Our research results are made known to others by publication in our own reports or in the journals of learned societies; by participation in scientific and technical meetings; by technical conferences sponsored and conducted by the NASA to provide available information in specific technical areas; and by many daily consultations. In return we learn of the problems of those who develop and operate aircraft and thus receive the guidance we need to make our research programs more directly applicable.

Formal, effective mechanisms for coordination and information exchange also exist. Among these are the NASA research advisory committees composed of members from industry, the scientific community, other Government agencies, and NASA. Four of these committees, those on aircraft aerodynamics, aircraft structures, air-breathing propulsion, and aircraft operating problems, are concerned only with aeronautics. These committees represent a direct extension of the effective committee system of the former NACA.

Coordination with the Department of Defense including the three military services, exists on many levels and through various mechanisms, the most prominent one being the Aeronautics Panel of the Aeronautics and Astronautics Coordinating Board. This panel is chaired by Admiral Booth, with the Director of the NASA's Aeronautical Division, as vice chairman, and has membership from the DOD, each of the military services, and NASA.

NASA wind tunnels have been employed in the research and development of every first priority military airplane and missile. These tests have involved independent evaluation by the government and in many cases extensive engineering modifications to improve proposed designs in advance of large-scale DOD procurement. Examples of this type of cooperation range from the XB-70 to single-place helicopters, from the Atlas and Minuteman to anti-tank devices.

In addition, the familiarity of NASA personnel with military requirements gained from specific development projects has encouraged their direct participation in the evolution of advanced concepts such as the TFX (F-111) multi-capability manned tactical combat aircraft that you have heard so much about recently. The F-111 represents a significant achievement in the military field that effectively illustrates the value of a continuing fundamental research program. The research conducted by our research centers, and in particular the Langley Research Center since 1959 culminated recently when General Dynamics was selected to develop the variable-sweep F-111 bi-service tactical fighter. I have here a model of one of the promising configurations of this airplane that we investigated. The F-111 will serve both the Air Force and Navy and will provide extreme versatility. When our research program in this area was initiated, there was no specific requirement for such an aircraft, since it was not realized that such versatility was possible. Our efforts in this area are now turned to the problems of the specific F-111 design to assist the military in obtaining a vehicle to meet its mission requirements.

Let us now turn our attention to the supersonic transport.

In 1956, after the design of the B-70 had been established, the NASA directed its attention to the supersonic transport. During 1957 and 1958, other elements of the aeronautics fraternity, both here in the U.S. and abroad, became interested in the feasibility of a supersonic transport.

In 1958 the NACA was abolished and absorbed as the nucleus of a new government agency, the National Aeronautics and Space Administration (NASA). During the same year, the Federal Aviation Agency was also established. Upon formation of the FAA, the NASA commenced immediately the establishment of a close working relationship analogous to that of the military to provide the most recent research information to ensure continued U.S. leadership in civil and military aviation.

In addition to specific areas of work, some of which have been previously mentioned, research in basic areas applicable to aeronautical vehicles is being continually pursued by the NASA. These include studies of new materials for airframes that will be required to operate for long periods of time at high temperatures, and new materials for high temperature air-breathing engine components which will increase engine efficiency and economy; noise to gain a better understanding of its origin and means of alleviation; boundary layer and boundary-layer control to reduce drag; structural concepts to provide reliable light-weight structures; air-breathing propulsion cycles and engine components to increase efficiency and permit the design of efficient light-weight engines for V/STOL aircraft, supersonic and hypersonic aircraft.

By December 1959 the NASA had generated sufficient technical information from its research efforts to indicate the technical feasibility of a commercial supersonic transport. On December 11, 1959, this information was brought to the attention of the FAA and the desirability of a national program for the development of such a vehicle was suggested. The technical information presented to the FAA at that time was subsequently published as NASA Technical Note No. TN D-423. From that beginning the joint FAA/NASA/DOD national program of assistance to the industry has grown as outlined in a report jointly prepared by the three agencies in June 1961, entitled "Commercial Supersonic Transport Aircraft Report." The role of the NASA, as stated in this report, is to provide technical support and conduct the necessary basic research for the program. Since June 1961 we have been engaged in applying our current technology to demonstrate the broad technical feasibility of an aircraft meeting anticipated requirements of the airlines, financial interests, and the public. During the course of this research several promising conceptual configurations for a supersonic transport emerged. The conceptual designs, despite the attraction of their aerodynamic efficiency, raised many questions regarding their practical feasibility. Such questions were largely of an engineering nature and could only be answered by a diligent, comprehensive engineering design study - a type of activity involving a competence and capability found only in industry. Accordingly, last February the NASA enlisted the aid of industry for the application of its engineering know-how to study, evaluate, and compare promising conceptual designs in all the areas of concern to a practical design. Such studies provide an important feedback to our research program. The results of these studies, together with summaries of NASA in-house research pertinent to the supersonic transport, were recently presented to the industry, the FAA, the military and other government agencies in a three-day conference held at our Langley Research Center on September 17, 18, 19, 1963. The proceedings of this conference have since been published in a 500-page classified document and distributed to the conferees and others possessing a need-to-know and security clearance who have requested it. The conference was attended by about 300 people (the capacity of our auditorium at Langley). An important and major objective of the industry studies was to define problem areas that need further research work for their solution and new problems that may have been overlooked. Some of the broad major conclusions of the studies are as follows:

> Variable sweep provides improvements in mission versatility, low-speed handling qualities, and a reduction in community noise.

Delta-type wings provide low structural weight and good longitudinal handling characteristics for most operating conditions.

The sonic boom has become a dominant factor in design with effects on the gross weight and range comparable to lift-drag ratio, specific fuel consumption, and structural weight. It is clear that great care must be exercised both in specifying the limiting sonic-boom requirements and in configuring the airplane so as to obtain a minimum sonic-boom.

New and advanced engines are required for the airplane. An associated major research and development effort will be required in the areas of air inlets, jet exits, and propulsion system controls.

Major reductions in gross weight and sonic-boom intensity comparable to the gains obtained by the use of advanced engines are obtainable by the use of titanium as the basic structural material and also by substantial reduction of the fuel reserves such as might become feasible following improvements in air traffic control and landing systems. It appears mandatory that these avenues of improvement be exploited.

Within the ground rules of the study, M-3 airplanes with advanced engines and titanium structures have lower gross weights and lower levels of sonic boom overpressures on the ground than lower-speed aluminum airplanes.

Finally, the overall implication of the results of the studies is that highly advanced airframe and engine configurations are needed to meet the objectives of the national program.

Skeptics have indicated that an economically practical commercial supersonic transport is so close to the limit of the state-of-the-art that small losses in calculated estimates will make the aircraft a "white elephant." The converse is also true - small gains will yield large dividends. We know we are pushing the state-of-the-art and that with further research, significant improvements can be made in a number of areas during the airplane development process. For example, the following improvements beyond the state of aircraft technology are considered to be individually attainable:

Reduce fuel reserves by 17%

Increase airplane lift-to-drag ratio by 7%

Reduce engine specific fuel consumption during cruise by 3%

Reduce engine weight by 15%

Reduce airframe structure weight by 5%

If all of these gains can be achieved simultaneously the payload can be increased 34% for a given weight aircraft designed to fly 4,000 statute miles. This is a very substantial improvement over current capabilities and provides a much more attractive airplane for the world's airlines. The question, of course, is how soon can we realize these improvements and can they be realized in one design? Our research effort at NASA is continuing with the objective of solving outstanding specific problems and bringing about a general upgrading of aircraft capabilities.

Our overall program of supersonic transport research includes extensive work in the following areas:

Advanced configuration concepts such as improved versions of the present configurations shown here.

Basic and configuration aerodynamics

Propulsion (engine combustion cycles, air inlets, jet exits)

Sonic boom and noise

Materials and their fabrication

Fail-safe structures

Handling-qualities

Operating problems and airworthiness

We are about to undertake a challenging and difficult development, but one that we can handle by a reasonable stretching of today's technology.

We are satisfied that our foundation of technology is firm enough to support such an undertaking and we now face the next logical step beyond the laboratory.

Perhaps the most important thing to bear in mind is that today we are literally only on the threshold of the supersonic transport era. The research and development that has been expended for the development of a supersonic transport must be continued and expanded. Aerodynamics, structures, and propulsion have always been important to the designer. They are even more important today. The supersonic transport is an important subject, one in which the stakes will be extremely large. Both the quality and the extent of the Government research program must be consistent with the scope of the problem. These research efforts must be extended for many years if the kind of a program which the American public has come to expect of joint Government-industry efforts is to be achieved. We enter the supersonic era confident that a superior United States airliner can be achieved but fully cognizant of the extent of the effort which lies ahead.

In this statement, I have attempted to describe how the NASA and the NACA before it has performed its function in providing the Nation with the research information and advanced technology to maintain our leadership in the world in aviation, and in particular, our more recent and current function with regard to the supersonic transport. The supersonic transport program is but one example of cooperation between NASA and other Government agencies and the industry. This unique program was initiated on the basis of NASA conceptual studies demonstrating the technical feasibility of such an airplane. We believe that it should continue on an accelerated basis. The wisdom of prompt action and assumption of responsibility by the FAA-NASA-DOD and the Congress for the effort conducted over the past two years has been confirmed by the heavily-funded entry of France and Great Britain in the supersonic transport field.

The NASA is continuing its research program and stands ready to shoulder its full share of responsibility in the development of a U.S. commercial supersonic transport aircraft.